

38481-8041.US01

Patent

UNITED STATES PATENT APPLICATION
FOR
INVENTORY BALANCE COMMON OBJECT

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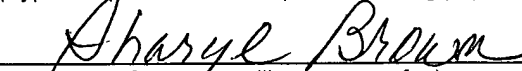
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Date of Deposit October 28, 2003

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EV 099149535 US
Attorney Docket: 38481-8041.US01

INVENTORY BALANCE COMMON OBJECT

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/457,434 filed March 24, 2003, entitled, "INVENTORY BALANCE SYNCHRONIZATION AND COMMON OBJECT," by Kahlon et al., and which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention is directed to the field of data modeling in the context of enterprise resources planning, supply chain management, warehouse management, and customer relations management, and more specifically to inventory management.

BACKGROUND

[0003] Manufacturers and suppliers of products use back-office computerized systems to provide support for functions in enterprise resources planning (ERP), supply chain management (SCM), and warehouse management (WMS). Such functions include manufacturing, marketing, inventory control, procurement and financing.

[0004] Also available are front-office computerized systems, which provide support to product vendors and distributors. In the context of inventory management, such front-office functions include analysis of historical

customer demand for products, stocking and replenishment of inventory, and providing information resources for delivery of inventory and service to consumers. In order to take advantage of such front-office software computerized systems, their users typically must store data in forms usable by the front-office computerized system, which often differ significantly from the forms usable with back-office computerized systems.

[0005] Thus, when some or all aspects of inventory are managed by both back-office and front-office computerized systems, there is a need to synchronize the inventory information in both computerized systems. Generally, in order for front-office computerized systems to communicate with back-office computerized systems that are already being used, the user must manually regenerate data from the back-office computerized systems in forms usable by the front-office computerized systems, and vice versa. Such manual regeneration has several significant disadvantages, including: (1) it is often expensive; (2) it often requires a substantial amount of time to complete; (3) it must be repeated each time data changes in either the back-office system or the front-office system; and (4) it is prone to errors.

[0006] In view of the foregoing, an automated approach for transforming data used by a back-office computerized system for use by a front-office computerized system, and vice versa, is needed.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0007] FIG. 1A is a high level network diagram showing aspects of a computerized environment in which the facility operates, according to certain embodiments.
- [0008] FIG. 1B is a block diagram that illustrates some business components of target system 130, according to certain embodiments.
- [0009] FIG. 2 is a block diagram showing some of the components typically incorporated in at least some of the computer systems and other devices on which the facility executes.
- [0010] FIG. 3A is a high level flow diagram that shows some steps performed by the facility.
- [0011] FIG. 3B and FIG. 3C are flow charts that illustrate further aspects of the data integration operation, according to certain embodiments.
- [0012] FIG. 4 to FIG. 11 are data structure diagrams that illustrate the inventory balance common object model, according to certain embodiments.

DETAILED DESCRIPTION

- [0013] According to certain embodiments, the synchronization of inventory information addresses the needs of a company that deploys multiple computer applications, obtained from multiple vendors of computer applications, in the company's inventory management system. The synchronization operation provides a user of the inventory management

system the same view of the inventory information across the various computer applications. All changes in the inventory information need to be captured and made accessible to all relevant computer applications in the inventory management system. For example, when an inventory item is received into inventory, shipped for an order, or has a change in its availability status (such as "reserved" status from "on hand" status), such inventory information need to be captured and made accessible to relevant computer applications in the inventory management system.

[0014] For purposes of explanation, assume that a company's inventory management system includes a front-office system for customer interfacing operations. Further, assume that the company's inventory management system also includes a back-office system that includes an inventory cost accounting application, for example. The computer applications of the front-office system uses a data model that is distinct from the data model used in back-office system's computer applications.

[0015] Inventory items are physically stored in a central distribution warehouse, at a field service office, in one or more field service engineer's trunk, or at a third party vendor's location. Assume that the various computer applications associated with inventory management used by the central distribution warehouse, the field service office, the field service engineer, and the third party vendor, are part of the front-office system. An inventory cost accounting application, for example, from the back-office

system will need to share inventory information with the front-office system computer applications. Thus, a common data storage model is needed so that the various computer applications across the company's inventory management system can share the inventory information.

[0016] When a front-office call center receives an order from a customer, the call center can commit the availability of inventory parts and labor to the customer even though such inventory parts are stocked by different partners across a multiplicity of systems, only if the call center and the multiplicity of systems share inventory information. An important aspect to the inventory management is to ensure that the multiplicity of applications across the systems share the same inventory balance information. Thus, any inventory balance information that occurs in the front-office needs to be synchronized with that of the back-office.

[0017] Inventory balance implies the quantity available for a product (stock keeping unit) at an inventory location for a particular inventory level. A stock keeping unit is an instance of a product (part number) at an inventory location. An example of a stock keeping unit is "30 GB Hard Drive" at "Chicago Field Office". Inventory level is also known as a product bucket. Inventory level is a classification of a stock keeping unit, based on its availability code and status code. Examples of availability codes are "on hand-good", or "on hand-defective", or "customer owned-good", etc.

[0018] To explain, the synchronization of inventory balance information is the process of synchronizing the Inventory Balance information between the back-office systems (source systems or external systems) and the front-office systems (target systems). For purposes of explanation, the synchronization of inventory balance information is described with reference to the back-office systems as source systems or external systems and the front-office systems as target systems. The inventory balance information is stored per inventory location, per product, and per bucket in all the relevant systems. Synchronization is made possible by using an integration process that assumes that the application from the source system (source application) is the master of the inventory balance information, and will update the target inventory balance information to reflect the balance in the source system. The inventory balance information in the target system is updated by creating a transaction that will result in the right balance for the particular inventory location. For example, inventory balance is updated by committing an inventory transaction.

[0019] An inventory balance record contains the Inventory location Id, the inventory product Id, the bucket code, and the quantity of products available per bucket. The integration application process for synchronizing inventory balance information may be invoked at regular intervals by the source system in order to update the target system's

Inventory Balance to reflect the source system's inventory balance information.

[0020] The inventory balance integration application process (IAP) includes the following operations:

- Extracting Inventory Balance information from Source Application.
- Transforming the Source-specific Inventory Balance information to a common object.
- Invoking the Sync Inventory Balance Integration Flow.
- Transforming the common object to the target application's format.
- Querying the target system for the Inventory Location's current balance
- Creating a new target Inventory Transaction Object based on the difference between the source and the target system's Inventory Balance.

[0021] The above inventory balance integration process occurs at periodic intervals when the inventory balances between inventory systems are not the same. There may be multiple reasons for the inventory balances between inventory systems to be different. For example,

- Inventory transactions synchronization may have failed for some transactions

- Inventory transaction synchronization may not have been activated.

The requirement is to update the balance at periodic intervals.

- Inventory transaction IAP is not applicable to enterprises in a distribution network such as between a manufacturer and distributor.

[0022] In some cases, the back office system may be the system that performs inventory transactions and the front-office may be used to reflect the inventory balances. In that case, the back office application will pass the inventory balance to integration server. The integration server will convert the balance into an inventory transaction (after accounting for the difference between the current balance in the front-office versus the current balance in the back-office) and submit such a transaction to the front-office system's database. Thus, the inventory balance information in the front-office system (target system) is updated by generating an inventory transaction to account for the difference (delta).

[0023] Inventory balance information includes the source inventory location name, the product, and the balance of inventory. If the product is serialized, then a list of asset/serial number is specified. The number of assets specified is equal to the balance field. The integration server will request the current balance from the target application (which is an application of the front-office system). At that point, the integration server may lock the balance record so that no more changes can be made to the

record until the synchronize inventory balance transaction complete. The integration server will compare the balances and create an inventory transaction for the delta.

[0024] The following is a process flow for synchronizing inventory balance information between source and target systems.

- A process is triggered in source application (external application) to send the inventory balance at a regular interval.
- Integration server receives the inventory balance information from source system.
- The integration server fetches the balance that is in the front-office system (target system).
- Compares the balances to create an inventory transaction.
- User verifies that the necessary information is filled in or defaulted:
Source Inventory location – External Location
Product
Quantity
Source Inventory level availability
Source Inventory level status
Destination Inventory location
Destination Inventory level availability
Destination Inventory level status
Serial # (if applicable)
Parent asset # (if applicable – when the inventory item is being installed/replaced on-site)
Description – Synchronize Inventory balance
Commit – True
- The transaction is committed in the target system database.

- The inventory balance information may be same in both systems.
For a non-serialized product, no transaction is generated in such a case. However, for serialized products, if the serial numbers are different then an inventory transaction would still need to be generated in order to synchronize the serial numbers.
- The inventory transaction is committed and the inventory balance updated.

[0025] The following is the common object definition for Inventory Balance information, according to certain embodiments of the invention. The information that the common object for Inventory balance may include the following:

Field	Description	Example
Inventory ID	Unique ID of the Inventory Location	ROWID of Inventory Location
DUNS #	Default Org DUNS #	
<u>Products</u>		
Product ID	Unique Product ID	ROWID for the Product
Product UOM	Unit Of Measure	Unit Of Measure for Product
<u>GlobalProductId</u>	Global Product Identifier	
<u>Inventory Level</u>		
Availability	LOVs from FS_PRODINVCAT_AVAIL	On Hand/In Transit/On Order/etc.
Status	LOVs from FS_PRODINVCAT_STATUS	Good/Defective
Quantity	Integer	10

[0026] A software facility (hereafter "the facility") for automatically converting inventory balance information, is described. In some embodiments, the facility converts inventory balance information from a form used by the source system to a form used by the target system. In certain embodiments, back-office systems are those that provide support for such functions as manufacturing, marketing, inventory control, procurement and financing. In certain embodiments, front-office system are those that provide support for such functions as analysis of historical customer demand for products, stocking and replenishment of inventory, and providing information resources for delivery of inventory and service to consumers, and sales.

[0027] In some embodiments, such as embodiments adapted to converting inventory balance information in the first source format, the facility converts inventory balance information by converting the inventory balance information that is in the first source format into an intermediate format. The intermediate format is then used to convert the inventory balance information into the target format.

[0028] By performing such conversions, embodiments of the facility enable a user of a first computerized system who has stored inventory balance information in a first format for use by the first computerized system to readily make the stored inventory balance information available for use in

a second computerized system that utilizes a second format in a cost-efficient and time-efficient manner.

[0029] FIG. 1A is a network diagram showing aspects of a typical hardware environment in which the facility operates. FIG. 1A shows a source system 110, a target system 130, an integration server 120 and a network 150. Source system 110 stores inventory balance information in a source format. There may be more than one source system. Target system 130 stores inventory balance information in a target format. There may be more than one target system.

[0030] The facility (not shown) converts some or all inventory balance information that is in the source format into the target format by using an intermediate format of the inventory balance information. In certain embodiments, such conversions are performed with the aid of one or more other computer systems, such as integration server system 120. Components of the facility may reside on and/or execute on any combination of these computer systems, and intermediate results from the conversion may similarly reside on any combination of these computer systems.

[0031] The computer systems shown in FIG. 1A are connected via network 150, which may use a variety of different networking technologies, including wired, guided or line-of-sight optical, and radio frequency networking. In some embodiments, the network includes the public

switched telephone network. Network connections established via the network may be fully-persistent, session-based, or intermittent, such as packet-based. While the facility typically operates in an environment such as is shown in FIG. 1A and described above, those skilled in the art will appreciate the facility may also operate in a wide variety of other environments.

[0032] FIG. 2 is a block diagram showing some of the components typically incorporated in at least some of the computer systems and other devices on which the facility executes, including some or all of the server and client computer systems shown in FIG. 1A. These computer systems and devices 200 may include one or more central processing units ("CPUs") 201 for executing computer programs; a computer memory 202 for storing programs and data -- including data structures -- while they are being used; a persistent storage device 203, such as a hard drive, for persistently storing programs and data; a computer-readable media drive 204, such as a CD-ROM drive, for reading programs and data stored on a computer-readable medium; and a network connection 205 for connecting the computer system to other computer systems, such as via the Internet, to exchange programs and/or data -- including data structures. While computer systems configured as described above are typically used to support the operation of the facility, those skilled in the art will appreciate

that the facility may be implemented using devices of various types and configurations, and having various components.

[0033] It will be understood by those skilled in the art that the facility may transform inventory balance information from a number of different source systems and from a number of different source software packages to a number of target systems and/or to a number of target software packages.

[0034] FIG. 1B is a block diagram that illustrates some business components of a front-office inventory system 132. According to certain embodiments, such business components include a central distributing warehouse 152, a multiplicity of field offices 154, 156, a plurality of trunks, such as trunk 158, and one or more call centers, such as call center 160. Such business components in front-office inventory system 132 use and store inventory balance data in the front-office system format. Further, one of the primary functions of front-office inventory system 132 is to serve and interface with customers 162.

[0035] FIG. 3A is a high level flow diagram that shows some steps typically performed by the facility in order to convert inventory balance information from the one or more source formats to the target format. At block 301, the facility extracts inventory balance information from one or more source systems. At block 302, the facility converts the extracted information into an intermediate format. The intermediate format is described in greater detail herein, with reference to the common object

data model. At block 303, the facility synchronizes the inventory balance information from the source system with that of the target system by converting the inventory balance information in intermediate format into the target format. After block 303, the steps as shown in FIG. 3A conclude.

[0036] FIG. 3B and FIG. 3C are flow charts that illustrate further aspects of the data integration operation, according to certain embodiments. In FIG. 3B, at block 310, a source application specific adapter listens for the synchronize inventory balance messages from a source application program in the source system. At block 312, a source application specific object (source ASO) that is associated with the message is extracted. At block 314, the source application specific adapter passes the source ASO to a source application transformation flow (SATF) across an application specific interface (ASI). At block 316, the SATF maps the source ASO to the inventory balance common object model (COM) to create a corresponding inventory balance COM instance. At block 318, the inventory balance COM instance is passed to the Synchronize Inventory Balance Integration Flow (SIBIF), via the common service interface (CSI). At block 320, the SIBIF passes the inventory balance COM instance to the target application transformation flow (TATF), via CSI. At block 322, the TATF transforms inventory balance COM instance to the target application specific inventory location object.

[0037] In FIG. 3C, at block 324, the target application specific inventory location object is passed to the target application specific adapter via ASI. At block 326, the target application specific adapter uses the target application specific inventory location object to query the target system for the target system's inventory balance information. At block 328, the TATF uses the target system's inventory balance information to create new target specific inventory transaction objects. At block 330, the new target specific inventory transaction objects are sent to the target application specific adapter to update the inventory balance information in the target system. Thus, the inventory balance information in the target system is synchronized with that of the source system.

[0038] FIG. 4 to FIG. 11 are data structures of the inventory common object model associated with inventory balance information. Such an inventory common object model illustrates sample intermediate data structures produced from corresponding inventory balance information in the source format.

[0039] In FIG. 4, the intermediate data structure 400 is of type listOfInventoryBalance (list of inventory balance), which may contain any number of inventoryBalance data structures 410 (inventory balance). One such illustrated inventoryBalance data structure 500 is shown in FIG. 5.

[0040] In FIG. 5, inventoryBalance data structure 500 includes a relatedInvLoc 502 section (inventory balance related inventory location),

and a listOfInventoryBalanceData section 504 (a list of inventory balance data). In FIG. 5, inventoryBalance data structure 500 may also include various other information such as various inventory transaction customData 506 (inventory balance custom data). The relatedInvLoc section 502 is discussed in greater detail herein with reference to FIG. 6. The listOfInventoryBalanceData section 504 is discussed in greater detail herein with reference to FIG. 7.

[0041] In FIG. 6, the relatedInvLoc section 600 includes an inventory balance related inventory location ID 610. In Fig. 7, listOfInventoryBalanceData section 700 includes any number of inventoryBalanceData sections 710 (inventory balance data). In Fig. 8, inventoryBalanceData section 800 includes a relatedProduct section 802 and a listOfBalanceData section 804. In FIG. 9, the relatedProduct section 900 includes an ID 910, which is an identifier for a product or item within the specified inventory location. In FIG. 10, the listOfBalanceData section 1000 includes a balanceData section 1010.

[0042] In FIG. 11, the balanceData section 1100 includes an inventory balance bucketCode 1102, an inventory balance quantity 1104, a product UnitOfMeasureCode 1106 and an inventory balance customData 1108. The inventory balance bucketCode 1102 can have values such as, "On Hand Good", "On Hand Defective", "Customer Owned Good", "Customer

Owned Defective”, etc. The inventory balance quantity 1104 is the quantity for the particular product at the particular inventory location.

[0043] It will be appreciated by those skilled in the art that the above-described facility may be straightforwardly adapted or extended in various ways. For example, the facility may be used to transform various other kinds of inventory balance information, and may be used to transform inventory balance information between a variety of other formats.

[0044] In the foregoing specification, embodiments of the invention have been described with reference to numerous specific details that may vary from implementation to implementation. Thus, the sole and exclusive indicator of what is the invention, and is intended by the applicants to be the invention, is the set of claims that issue from this application, in the specific form in which such claims issue, including any subsequent correction. Any express definitions set forth herein for terms contained in such claims shall govern the meaning of such terms as used in the claims. Hence, no limitation, element, property, feature, advantage or attribute that is not expressly recited in a claim should limit the scope of such claim in any way. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.